Biogeomorphodynamic of fluvial-tidal levees and accommodation space infilling

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Densely populated low-lying areas are under pressure of relative sea level rise and human impacts. Low-lying areas like most of The Netherlands were built with fluvial-marine sediment supply interacting with peat and vegetation. The morphology and sedimentological architecture of such areas is controlled by initial conditions (e.g. accommodation space), boundary conditions (fluvial-tidal discharges) and internal biogeomorphodynamic feedbacks. The relative importance of these controls varies per system and we need generic rules to better understand the past and future delta and alluvial plain evolution. Here we setup novel long-term idealized morphodynamic models including stratigraphy and vegetation to unravel the effect of initial and boundary conditions in building landscape and creating complex depositional environments. Larger accommodation space creates and preserves a bayhead delta while limited space resulted in ebb-delta growth. Fluvial-tidal discharge fluctuations promote larger levees and more crevasses, contributing to floodplain accretion. The presence of sparse vegetation (i.e. trees) also contributed to floodplain infilling and created wide levees and more crevasses. On the other hand, dense vegetated floodplain inhibits levee widening and the formation of crevasses leaving the floodplain rather starved. Our results agree with the dimensions and evolution from geological reconstructions of the Rhine Delta in The Netherlands. In general, discharge fluctuations by rivers and tides, sediment delivery and (sparse) vegetation are crucial to create more land. These findings are important for the reconstruction of past environments and sediment budget estimative as well to future management of low-lying areas where raising the land-level is a challenge.